



**Competency 1.6 Industrial hygiene personnel shall demonstrate a working level knowledge of sampling techniques.**

**1. Supporting Knowledge and Skills**

- a. Describe how investigative techniques are used to determine sampling techniques.
- b. Describe the significance of instrument calibration and operation, and data collection methods during sampling.
- c. Discuss conditions which could require adjustments to the sampling plan to meet changing conditions.
- d. Describe how multiple exposures affect sampling techniques.
- e. Describe the factors (concentration, duration, frequency, etc.) that determine the adequacy of samples.
- f. Describe how environmental factors (wind, rain, temperature extremes, etc.) affect the need for further sampling.

**2. Recommended Reading**

**Review**

- *Fundamentals of Industrial Hygiene*, 3rd Edition or later edition, National Safety Council, Chapters 16, 17, 18, and 19.
- Patty's *Industrial Hygiene and Toxicology*, 4th Edition, Volume I, Chapters 27, "Industrial Hygiene Samples and Analysis."
- NIOSH-recommended *Employee Exposure Determination and Measurement Strategy*, Occupational Exposure Sampling Strategy Manual, NIOSH Pub. No. 77-173.



### **3. Summary**

In situations where immediate decisions are required, direct-reading instruments may be the only sampling method available. Because the information they provide is limited, the proper interpretation of this data is dependent on the experience and imagination of the industrial hygienist. In general, when plans and time allow, integrated personal sampling covering the entire duration of a representative operation is preferred, but this may not always be possible. When personal sampling is not possible, integrated area sampling may provide adequate information if carefully interpreted. If sampling over the full shift is not possible, the performance of consecutive direct-reading or grab samples and their interpretation in accordance with standard methods may also yield useful information.

Instruments must be calibrated before and after sampling. Most instruments also require additional periodic calibration in a laboratory. In the field, personal sampling pumps should be constantly monitored to ensure their continued operation. The performance of direct-reading sampling in association with integrated sampling may provide corroborative or supplemental information detailing changing levels throughout the operation. All calibration and instrument monitoring information, as well as descriptive information of the operation that could influence the sampling results, should be recorded on the sampling sheet.

Exposure to more than one hazardous agent may require the use of more than one sampling instrument by the same employee. More than one sampling instrument may also be required if substances of interest require the performance of incompatible laboratory analyses. The potential for chemical interferences may also require the use of more than one sampling method and create complications in the interpretation of results.

In order for the sample to be of much value, the level of detection must be lower than the criterion level of interest, either the AL or permissible exposure limit (PEL), but preferably much lower. In order to ensure that the level of detection is as low as possible, the sample must contain a minimum volume of air. This, in general, requires a minimum sample duration. Duration is also important when the sample is being related to specific criterion, e.g., short-term exposure limits (STELs), ceilings, etc. If possible, sampling should be performed for the entire duration of the operation being characterized. When sampling is performed for less than eight hours because the operation was completed in that time, this fact should be noted on the sampling sheet in order to justify the assumption that personal exposure for the remainder of the day was zero.



The frequency of sampling may be listed in a few expanded OSHA regulations; however, normally this is dictated by professional judgment. In general, initial measurements should be taken whenever it is believed that significant exposure is possible. A second set of measurements taken sometime after the first set is also advisable as a check against possible variation in operations. If both sets of results show insignificant exposure, sampling may probably stop. Continued surveillance of work places is necessary in order to verify that new operations have not been initiated and that previously characterized operations have not changed so as to increase the potential for exposure.

Environmental extremes may influence instrument operation. Extreme cold, for example, may affect pumps, direct-reading instruments, and detector tube operation. High moisture or humidity resulting in condensation may also affect operation of dosimeter microphones and the reliability of sampling media. Wind may also affect noise measurement. In general, potential environmental limitations and interferences will be clearly described in the instrument operator's manual and in standardized sampling and analytical methods, and the industrial hygienist should take note of them.

If results of monitoring are significant, periodic sampling may be required, largely in order to verify the continuing adequacy of controls then in place. Probably, the higher the previous results and more dangerous the agent, the more frequent subsequent samples should be performed. Follow-up to initial sampling may also be required if modifications in a process of controls would indicate the possibility for increased exposure over earlier samples, and to verify that new engineering controls are performing as expected.

#### **4. Suggested Exercises**

Please refer to Scenarios 5 and 6 in the Scenario section of this document.